

AMENDMENTS TO THE CLAIMS

Claim 1 (Currently Amended) An acoustic mirror type thin film bulk acoustic resonator comprising:

a substrate;

an acoustic mirror layer disposed ~~provided~~ on the substrate, the acoustic mirror layer including a plurality of impedance layers alternately having a high acoustic impedance and a low acoustic impedance; and

a piezoelectric thin film vibrator disposed ~~provided~~ on the acoustic mirror layer, the piezoelectric thin film vibrator including a lower electrode, a piezoelectric thin film and an upper electrode,

wherein ~~the~~ a sum of a thickness of the lower electrode and a thickness of the upper electrode is between 5% ~~or more~~ and 60% ~~or less~~ of a ~~whole~~ thickness of the piezoelectric thin film vibrator, and

wherein the thickness of the lower electrode is larger than the thickness of the upper electrode.

Claim 2 (Currently Amended) The thin film bulk acoustic resonator according to claim 1, wherein:

the plurality of impedance layers includes a plurality of low acoustic impedance layers and a plurality of high acoustic impedance layers which are alternately disposed; ~~[[,]]~~ and

an uppermost one of the low acoustic impedance layers which contacts the lower electrode, has a thickness of one fourth of an acoustic wavelength defined from a resonant frequency in free space of the piezoelectric thin film vibrator.

Claim 3 (Previously Presented) The thin film bulk acoustic resonator according to claim 2, wherein each of the plurality of low acoustic impedance layers has a thickness of one fourth of the acoustic wavelength defined from the resonant frequency in free space of the piezoelectric thin film vibrator.

Claim 4 (Currently Amended) The thin film bulk acoustic resonator according to claim 1, wherein:

the plurality of impedance layers includes a plurality of low acoustic impedance layers and a plurality of high acoustic impedance layers which are alternately disposed;[[,]] and

an uppermost one of the low acoustic impedance layers which contacts the lower electrode, has a thickness of less than one fourth of an acoustic wavelength defined from a resonant frequency in free space of the piezoelectric thin film vibrator.

Claim 5 (Previously Presented) The thin film bulk acoustic resonator according to claim 4, wherein each of the plurality of low acoustic impedance layers has a thickness of less than one fourth of the acoustic wavelength defined from the resonant frequency in free space of the piezoelectric thin film vibrator.

Claim 6 (Currently Amended) The thin film bulk acoustic resonator according to claim 1, wherein:

the plurality of impedance layers includes a plurality of low acoustic impedance layers and a plurality of high acoustic impedance layers which are alternately disposed;[[,]] and

an uppermost one of the low acoustic impedance layers which contacts the lower electrode, has a thickness of more than one fourth of an acoustic wavelength defined from a resonant frequency in free space of the piezoelectric thin film vibrator.

Claim 7 (Previously Presented) The thin film bulk acoustic resonator according to claim 6, wherein each of the plurality of low acoustic impedance layers has a thickness of more than one fourth of the acoustic wavelength defined from the resonant frequency in free space of the piezoelectric thin film vibrator.

Claim 8 (Currently Amended) The thin film bulk acoustic resonator according to claim 1, wherein:

the plurality of impedance layers includes a plurality of low acoustic impedance layers and a plurality of high acoustic impedance layers which are alternately disposed;
and

at least an uppermost one of the plurality of low acoustic impedance layer, has a thickness different from one fourth of an acoustic wavelength defined from a resonant frequency in free space of the piezoelectric thin film vibrator[[,]]; and

an uppermost one of the high acoustic impedance layers has a thickness different from one fourth of the acoustic wavelength defined from the resonant frequency in free space of the piezoelectric thin film vibrator.

Claim 9 (Previously Presented) The thin film bulk acoustic resonator according to claim 8, wherein each of the plurality of high acoustic impedance layers has a thickness different from one fourth of the acoustic wavelength defined from the resonant frequency in free space of the piezoelectric thin film vibrator.

Claim 10 (Currently Amended) A filter comprising two or more thin film bulk acoustic resonators which are connected in a ladder form, wherein

at least one of the thin film bulk acoustic resonators comprises:

a substrate;

an acoustic mirror layer ~~disposed~~ provided on the substrate, the acoustic mirror layer including a plurality of impedance layers alternately having a high acoustic impedance and a low acoustic impedance; and

a piezoelectric thin film vibrator ~~disposed~~ provided on the acoustic mirror layer, the piezoelectric thin film vibrator including a lower electrode, a piezoelectric thin film and an upper electrode,

wherein ~~the~~ a sum of a thickness of the lower electrode and a thickness of the upper electrode is between 5% ~~or more~~ and 60% ~~or less~~ of a ~~whole~~ thickness of the piezoelectric thin film vibrator, and

wherein the thickness of the lower electrode is larger than the thickness of the upper electrode.

Claim 11 (Currently Amended) A duplexer comprising a transmission filter and a reception filter, wherein:

at least one of the transmission filter and the reception filter comprises two or more thin film bulk acoustic resonators which are connected in a ladder form[[,]]; and

at least one of the thin film bulk acoustic resonators comprises:

a substrate;

an acoustic mirror layer ~~disposed-provided~~ on the substrate, the acoustic mirror layer including a plurality of impedance layers alternately having a high acoustic impedance and a low acoustic impedance; and

a piezoelectric thin film vibrator ~~disposed-provided~~ on the acoustic mirror layer, the piezoelectric thin film vibrator including a lower electrode, a piezoelectric thin film and an upper electrode,

wherein ~~the~~ a sum of a thickness of the lower electrode and a thickness of the upper electrode is between 5% ~~or more~~ and 60% ~~or less~~ of a ~~whole~~ thickness of the piezoelectric thin film vibrator, and

wherein the thickness of the lower electrode is larger than the thickness of the upper electrode.

Claim 12 (Currently Amended) A communication apparatus comprising at least one thin film bulk acoustic resonator, wherein

the at least one thin film bulk acoustic resonators comprises:

a substrate;

an acoustic mirror layer ~~disposed-provided~~ on the substrate, the acoustic mirror layer including a plurality of impedance layers alternately having a high acoustic impedance and a low acoustic impedance; and

a piezoelectric thin film vibrator ~~disposed-provided~~ on the acoustic mirror layer, the piezoelectric thin film vibrator including a lower electrode, a piezoelectric thin film and an upper electrode,

wherein ~~the~~ a sum of a thickness of the lower electrode and a thickness of the upper electrode is between 5% ~~or more~~ and 60% ~~or less~~ of a ~~whole~~ thickness of the piezoelectric thin film vibrator, and

wherein the thickness of the lower electrode is larger than the thickness of the upper electrode.